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An International Congress on Forensic Medicine

Several organizations interested in the progress and development of forensic medicine have recognized the importance of convening an international congress. This will permit colleagues in many different countries to meet and discuss problems of common interest.

Momentous advances have taken place in the forensic field in recent years. This is evidenced by the comprehensive survey reflected in Keith Simpson's *Modern Trends in Forensic Medicine,* published in 1953 and dealing, *inter alia,* with forensic pathology, electro-encephalography in forensic medicine, problems in the civil law in relation to medical practice, as well as advances in toxicology. Moreover, the vigorous quality of new textbooks and new editions of standard works are also an index of the considerable contemporary activity in the medico-legal sphere. Not least are the important research contributions being published in the periodical literature.

The South African Medico-Legal Society has agreed to act as host to such an International Congress in Johannesburg, if this agreed upon, and it has entered into exploratory discussions with Dr. Francis E. Camps (Honorary Secretary of the British Association of Forensic Pathologists) and Dr. Charles P. Larson (Chairman of the Forensic Pathology Committee for the College of American Pathologists).

It is anticipated that the Congress could be held in about 18 months' time. Congress participants would, of course, travel at their own expense and further inquiries should be directed to the nearest convenient quarter, viz.:

Dr. Charles P. Larson,
Tacoma General Hospital,
Tacoma 5, Washington, D.C., U.S.A.;

Dr. Francis E. Camps,
37 Welbeck Street,
London, W.1, England;

or to the Editor of this Journal.

The Use of Drugs in the Examination of Suspected Criminals

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The use of drugs to obtain confessions from suspected criminals has attracted considerable public interest. The practice is not of recent origin, as alcohol has long been used to loosen tongues. In 1922, Robert E. House, a Texas physician, advocated the use of scopolamine as a means both of obtaining confessions from criminals and of clearing the innocent. He made the extravagant claim that, at a certain stage of scopolamine anesthesia, persons will reply to all questions with childlike simplicity, with childlike honesty, without evasiveness, guilt, deceit or fraud.[1] The term truth serum was coined to describe the use of scopolamine and has since been applied to any drug which is employed to obtain confessions. The description is misleading, as the drugs used are not sera and do not always lead to the truth. Scopolamine has been superseded by barbiturate drugs, which are injected intravenously. Sodium amytal is the drug of choice, and the dose required differs from patient to patient and in the same patient at different times. The dose should be sufficient to produce complete relaxation but not so great as to cause mental confusion. Success in eliciting information will depend on the skill and judgement of the physician. The technique is commonly called narcoanalysis.

There are many recorded instances of the successful use of drugs in obtaining confessions. Scopolamine was used in 1924, in Birmingham, Alabama, to obtain confessions from a group of axe murderers; in 1931, in Chicago, it was used to discover the hiding place of stolen securities and the whereabouts of missing robbers; in 1935 in Kansas City, police used it successfully to obtain a confession of murder. In 1946 in Chicago, a suspect who claimed amnesia confessed, under sodium amytal narcosis, that he had committed 3 murders and a number of burglaries. In 1953 in Denver, a murder suspect revealed the burial spot of his victim.

These well-publicized and dramatic successes probably account for the misguided public belief in the effectiveness and reliability of drugs as a

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means of obtaining confessions. State-employed psychiatrists are frequently requested to administer drugs to suspected criminals. It is timely, therefore, to review the medico-legal problems which arise from such a request.

Reliability of Narcoanalysis

Examination with the aid of drugs does not always lead to the truth. Persons, while under the influence of drugs, may show increased susceptibility to suggestion and false confessions of guilt may be made. In 1928, a murder suspect in Hawaii, while under the influence of hyoscine hydrobromide, confessed to writing the ransom note. This confession was found to be false when the real murderer was apprehended.[2] Gerson and Victoroff[3] report the case of a soldier who, while under narcosis, confessed to a robbery in which he had not participated. Ripley and Wolf[4] noted that some patients, while under the influence of sodium amytal, deliberately misrepresented facts. Redlich and others[5] carried out an experiment in which 9 volunteers were asked to maintain artificial lies in a sodium amytal interview. It was found that 3 of the 9 examined were able to continue the deception under sodium amytal. The motivation of these volunteers to withhold the truth would be less than in the case of criminals who would face imprisonment or even execution, if unsuccessful. These authors found that it was the neurotic individual, particularly the person with strong feelings of depression, guilt and anxiety, who confessed under sodium amytal. This personality type might be expected to confess even without the use of drugs. Experience shows that the person who is determined to lie will usually be able to continue the deception, even under the effects of a drug. The confident criminal relishes the prospect of making self-serving statements in the pseudo-scientific atmosphere of the truth serum test.[6] A criminal may choose to simulate a recovery of memory under drugs in order to form a basis for an insanity plea.[7] The test may, however, give reliable results when the suspect suffers from a genuine hysterical amnesia for the time in which the crime was committed.

Inbau,[8] who has had considerable experience with truth serum tests, is of the opinion that such tests are occasionally effective on persons who would have previously disclosed the truth anyway if they had been properly interrogated.

In summary, it may be stated that criminal suspects, while under the influence of barbiturate drugs, may deliberately withhold information, persist in giving untruthful answers or falsely confess to crimes they have not committed. Narcoanalysis is likely to be effective only in cases of hysterical amnesia or in persons who would be likely to confess anyway without the use of drugs. Its usefulness to law enforcement agencies is, therefore, confined to persons suffering from hysterical amnesia. Narco-

analysis should not be used as a substitute for skilled interrogation by competent police officers. Such a practice could only encourage inefficiency in police departments, who might use the technique as a substitute for the painstaking, time-consuming inquiries which form the basis of competent police investigation. The technique is not sufficiently reliable to be used for the purpose of exonerating the innocent.

Narcoanalysis and the Insanity Plea

Narcoanalysis is sometimes of value in the psychiatric examination of suspected criminals who have entered a plea of not guilty by reason of insanity. When the patient is mute and the underlying cause is not evident, narcoanalysis may restore speech and thereby reveal the correct diagnosis, whether it be psychosis, hysteria, epilepsy, organic brain disorder or malingering. The following is a case in point:

A 29-year-old laborer was alleged to have shot and killed a man following an argument in a dance hall. After his arrest, he did not speak. Police officers suspected that he was feigning insanity, as he interrupted his silence on occasion to make requests for articles such as shaving materials. On admission into hospital, he appeared to be in a state of stupor. He did not speak and did not appear to take any interest in what was going on around him. After the intravenous injection of sodium amytal, he became much more alert, spoke freely and did not show any evasiveness. His thought content revealed that he was suffering from a depressive stupor. Within a few hours, he lapsed into stupor again. Narcoanalysis served to dispel any suggestion that this man might be malingering.

Reticent, negativistic and uncommunicative patients may talk much more freely while under the influence of drugs. When there is clinical evidence suggesting psychosis, narcoanalysis may bring to light delusional ideas which have previously been withheld, as in the following case:

A 19-year-old youth was arrested on a charge of burglary. Against his wishes, his attorney entered a plea of insanity. His mother reported that, in recent months, he had changed from a friendly, outgoing youth to a sullen, morose and seclusive person. Clinical examination suggested, but not conclusively, the possibility of an early schizophrenic illness. During narcoanalysis, paranoid ideas were expressed, and these delusions continued after the patient had recovered from the effects of the drug. Without the evidence obtained following the use of drugs, it would have been impossible to have made a diagnosis of schizophrenia or to have convinced a jury that he was legally insane.

If there is clouding of consciousness during the interview, any psychotic material obtained may be the direct result of drug intoxication. Even in the absence of clouding of consciousness or underlying psychosis, bizarre statements may be made during narcoanalysis. Non-psychotic patients, while under the influence of drugs, may make fantastic statements, and care must be taken not to attribute these productions to psychosis.

Narcoanalysis is also indicated in cases of hysterical amnesia. It is important to distinguish between genuine amnesia and malingered amnesia, as the technique is not likely to be of value in cases of malingering. Genuine

hysterical amnesia conforms to a well-known clinical picture and is associated with psychological trauma. It is usually possible to diagnose faking without resorting to a technique which may be a source of much time-consuming cross-examination in a courtroom.

Legal Aspects of Narcoanalysis

The passage of legislation which would provide for the compulsory use of drugs on suspected criminals has been advocated by some law enforcement officers. It is unlikely that the involuntary use of drugs will ever be legalized because of the threat to individual freedom which would result. Depres[9] points out that the drugs could be used to explore the life and thought and wishes of anyone on whom the authorities choose to use them. Such a use, he adds, would threaten everyone without exception save those in political power. In 1948, the Council of the Bar Association of the Court of Appeal of Paris condemned the use of psychonarcosis in the course of judicial investigation. The Council believed that such a procedure violated a fundamental right of the accused by depriving him of his free will. The *Lancet*, in editorials,[10] makes some very scathing comments on the use of drugs:

'The infallible usefulness of any drug in obtaining the truth from an unwilling deponent would have to be established first beyond any question before any civilized judicial administration could countenance its use. But, even so, there would still be considerable difficulties to be overcome before British courts would accept as evidence any information obtained by such means. If prisoners are to be subject to examination under scopolamine, why should not the policeman at a police court, who gives evidence the truth of which the accused denies, submit to examination under scopolamine? Why should not all the witnesses for the prosecution or the defence receive the same test as the accused? Why should the prisoner be the only person scopolamined while others are only cross-examined? Further, why should the scientific ascertainment of the whole truth and nothing but the truth be limited to criminal cases. Perjury is not unknown in civil courts. It would be instinctively repulsive alike to judge, counsel and jury, apart even from the fact that British courts of law are conservatively distrustful of scientific discovery in its application to criminal investigation. To dope a man into confession would be as distasteful as to extract evidence by torture.'

Under American and British law, it is permissible to use drugs in criminal investigation when the suspect willingly gives his consent for such an examination. Should a confession be obtained by such means, it would be inadmissible in evidence because of the rule against involuntary confessions. The information thus obtained might, however, help the police to obtain further evidence which could lead to the criminal's conviction. The defense attorney may wish to offer in evidence a statement made by the defendant while under the influence of a drug. In sustaining the rejection of such an offer, the Supreme Court of Missouri in 1926, made the following statement:[11]

It was sought to introduce in evidence the deposition of a doctor residing elsewhere,

who testified to the effect that he had administered to the defendant what he termed a 'truth-telling serum,' and that while under its influence the defendant had denied his guilt. Testimony of this character—barring the sufficient fact that it cannot be otherwise classified than as a self-serving declaration—is, in the present state of human knowledge, unworthy of serious consideration. We are not told from what well this serum is drawn or in what alembic its alleged truth-compelling powers are distilled. Its origin is as nebulous as its effect is uncertain. A belief in its potency, if it has any existence, is confined to the modern Cagliostro, who still, as Balsamo did of old, cozen the credulous for a *quid pro quo*, by inducing them to believe in the magic powers of philters, potions and cures by faith. The trial court, therefore, whether it assigned a reason for its action or not, ruled correctly in excluding this clap-trap from the consideration of the jury. Cogent reasons based upon numerous rulings, cited in the respondent's brief, bear ample testimony to support the wisdom of the court's ruling.

Depres[9] comments that undoubtedly the ruling but not the language of the Missouri Supreme Court would be universally followed today even though modern psychiatrists effect cures with sodium pentothal of which Cagliostro and Balsamo never dreamed. The test is not sufficiently reliable to be used for the purpose of exonerating the innocent.

No appelate court in the United States ever permits truth serum testimony as evidence either for or against the defendant. When it has been entered as evidence, higher courts have overruled its admissibility. It is possible that on some future date courts will review the admissibility of such evidence on the ground of psychiatric progress, rather than on the basis of precedents dating back 30 years. In the meantime, courts would be wise to continue their present critical attitude toward the use of drugs.

Ethical Problems

Should a physician, on the request of the police, administer drugs to a suspect for the purpose of obtaining a confession? Lorenz[12] comments that this practice places the physician in a rather uncomfortable position, because through his medical knowledge and efforts a person is rendered more or less helpless. The efforts of the physician are not in the direction of helping and healing except when an innocent person is accused. The legal position in England has been defined by Lord Riddel[13] to the effect that a doctor shares with other citizens the duty to assist in the detection and arrest of a person who has committed a serious crime. Textbooks of forensic medicine subscribe to this viewpoint. Thus, Gordon, Turner and Price[14] believe that a physician may reasonably feel himself obliged to act in order to prevent crime or to bring a criminal to book. Nevertheless, many physicians would feel reluctant to perform narcoanalysis on a criminal suspect. When the crime is one of murder, the physician cannot lightly dismiss a request for help from the police. The following case illustrates the ethical problems which face the physician.

A young man was arrested following a perverse sexual assault on a middle-aged woman. While in custody, he confided to his cell mate that several years previously he had murdered

a young woman who had resisted his advances. This murder had been thoroughly investigated by the police without success. The suspect, when faced with his cell mate's accusations, denied having committed the murder and a lie detector test gave inconclusive results. The evidence of a fellow prisoner would be insufficient by itself to secure a conviction and the police requested a truth serum test. The prisoner expressed willingness to undergo the test. As the suspect had shown himself to be untruthful in other matters and as he had not responded to prolonged and competent police interrogation, it is doubtful whether narcoanalysis would elicit the truth. Nevertheless if the physician, on ethical grounds, refused to administer drugs and if the suspect later committed another similar murder, then doubtless the physician would be open to considerable public censure.

The physician who agrees to administer a drug to a criminal suspect on the request of the police should first obtain the suspect's written consent. The prisoner should be given an opportunity to consult an attorney and should be informed that he cannot be compelled to submit to examination while under the influence of drugs. Furthermore, the physician should confine himself to administering the drug and should take no part in the criminal interrogation. He should intervene only to check on the suspect's physical condition or to protect the suspect from possible coercion by the police.

A much more difficult ethical problem arises when a patient in treatment reveals under narcosis that he has committed a crime. Such a confession is a privileged communication and it would be unethical to reveal it to the police. If the patient states while under narcosis that he has committed murder, and if the confession does not appear to be mere fantasy, the physician is placed in an awkward predicament. In this regard, Kerr[15] believes that a doctor's duty as a citizen to assist in the apprehension of a person who has committed a serious crime outweighs his obligation to his patient. Many psychiatrists would not feel bound to reveal the confession to the police. Guttmacher and Weihofen,[16] in discussing privileged communications, emphasize the importance of the psychiatrist-patient relationship.

> We submit that the possible injustice that might be done by the suppression of evidence in individual cases is outweighed by the importance of assuring patients that the confidentiality of their relations with the psychiatrist is absolute, and not subject to violation even on a court summons.

Depres[9] holds a similar opinion.

> Suppose that in the course of his proper medical use of sodium pentothal, the physician hears the confession of a crime. May he reveal the crime? Must he reveal it if questioned? Since mentally ill people include many persons who are criminals as a result of their illness, there should be an assurance that the criminal personality who seeks the best mental treatment, like the penitent who seeks absolution, should be free to seek it and receive it without fear that his deeds would thereby be revealed.

Contrasting points of view held by eminent authorities have been presented. It is clear that there is no unanimity of opinion on the difficult ethical and moral problems posed by the patient in treatment who makes a criminal confession while under the influence of drugs.

There would appear to be no ethical objection to a psychiatrist performing narcoanalysis when this is indicated as part of the psychiatric examination of a suspected criminal who has entered a plea of not guilty by reason of insanity. The consent of the suspect should be obtained and information so obtained should not be used as evidence in determining the innocence or guilt of the accused unless the suspect or his attorneys request otherwise.

Summary

Criminal suspects, while under the influence of drugs, may deliberately withhold information, persist in giving untruthful answers, or falsely confess to crimes they have not committed. Those suspects with strong feelings of depression, guilt and anxiety who are likely to confess while under the influence of drugs are also likely to confess without the use of drugs, if skilfully interrogated by competent police officers.

Drug induced examinations are unreliable as a test of truth, and should not be used to exonerate the innocent. Narcoanalysis may be of value when the suspect suffers from a genuine hysterical amnesia for the time in which the crime was committed. Confessions obtained during narcoanalysis are inadmissible in evidence because of the rule against involuntary confessions.

The ethical problems involved will discourage many physicians from administering drugs to suspected criminals.

Narcoanalysis is of occasional diagnostic value in the psychiatric examination of suspects who have entered a plea of not guilty by reason of insanity.

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Narco-Interrogation*

C. B. Hanscom

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A few years ago I believed nomination to membership in this organization was among the greatest honours I could achieve. The privilege of appearing before you today is an even higher honour.

This is a *prospectus*: an analysis, and an accounting of the methods developed at the University of Minnesota for interrogation of criminal suspects during narcosis. Some of you will accept the challenge we offer, to try our methods, to duplicate, and to improve upon the results we have obtained. My missionary duties will be fulfilled if you only listen to the proposals which follow and recognize the tremendous usefulness this technique has in criminological investigation. The possibilities and potentialities we are to discuss are so broad and sweeping that only a brief review and summary are possible today.

Most of my experience in the field of detecting deception has been with the polygraph. I have frequently been asked about the limitations of this instrument and about the difficulties in interpretation of some of the recordings. At times we have been confronted with suspects with low mentality and with others who produce *'inconclusive charts'*, as you have heard them called.

But, on 28 September 1948, I began one of the most interesting experiences in more than 25 years in the field of investigation. In essence, a young man with a long record of arrests and convictions was charged with the brutal murder of a boy and girl he surprised in unusual circumstances on a golf course. The conviction of this man finally depended upon locating the murder rifle. Our polygraph examinations disclosed his guilt, and he reacted to any possible location of the rifle which involved a body of water. We were at a loss to select the correct lake, river, or pond into which we could send divers.

In desperation we turned to the only other method of investigation we

* Address presented by C. B. Hanscom, Director, Department of Protection and Investigation, University of Minnesota, Minneapolis, Minn., before the American Academy of Forensic Sciences, Biltmore Hotel, Los Angeles, California, on 17 February 1955.

had not tried in this case—an interrogation of the suspect while he was influenced by anesthetic drugs. After 3 or 4 hours of questioning we had a complete confession of the crime, a description of the location of the gun, and the post-hypnotic suggestion that the suspect actually would lead us to the spot from which he threw the weapon into the pond. As promised, he helped us locate the rifle, and the case was prosecuted successfully.

More than 30 different tests under narcosis have followed this dramatic beginning. They have been concluded to our satisfaction and validated by the facts subsequently disclosed. We have no evidence of a failure in the series. Although this record is unusual, the Minnesota technique is based upon a firm historical background.

History

A study of more than 230 references to narco-analysis for criminal interrogation revealed that the evolution of our modern methods depended, in every case, upon:

1. The discovery of a drug which had narcotic or anesthetic properties;
2. The use of this drug in psychiatry where it was shown to produce changes in personality; and
3. The application of this combined knowledge in criminology.

Recognizing this principle, those of us who were interested in improving the existing methods were obliged to continue testing newer drugs which have followed this pattern.

The process began as long ago as 1200 B.C. After the early explorations of opium, mandragora, the fumes of hemp, carbon dioxide and potions of wine, there were few additions until after the Dark Ages. Later the Mexican Indians extracted a crude form of mescaline, called peyotl, from the cactus plant. They derived religious hallucinations from its use, and also used it to obtain confessions and social secrets. The priests who served these Indians reported these facts to the Old World in the 17th century. Psychiatrists of the 20th century rediscovered the modification of personality that mescaline could produce, and are now studying its effects on the accessibility of repressed information.

The Scientific Revolution of the 17th and 18th centuries discovered nitrous oxide, ether and chloroform for anesthetic purposes. In a short time there were discussions of 'anesthetic revelations' and sporadic uses of the drugs in espionage, etc. In 1903 Dr. Wagner of New York used ether in the interrogation of a former police officer who was accused of murder. The technique he used in the penetration of this officer's malingering was closely similar to the very method we use today. What a shame his reports were not studied by the forensic scientists long ago!

Throughout the first half of the 20th century there was a steady and rapid increase in our knowledge of anesthetic drugs, psychiatric principles

and forensic methods. Narco-analysis for criminal interrogation was tremendously improved by the experimental and factual results gained from the First and Second World Wars. It was during this time that Dr. R. E. House, of Ferris, Texas, discovered that scopolamine was a powerful somnifacient and amnestic drug, which he claimed would produce the truth in more than 50% of his investigations of criminal suspects. His crusade attracted great publicity—during which the newspaper reporters coined the misleading term 'truth serum'—and established Dr. House as the modern father of this field of interest.

During the Wars our psychiatrists became proficient with sodium amytal and sodium pentothal in the exploration and treatment of mental illness. As we have been led to suspect, in a short time this information was brought into criminology, where we find them the backbone of most pharmacological methods of interrogation. Thanks to the same teamwork and intensive effort, we also have derived plausible explanations and theories to explain the steps whereby we can elicit confessions and assay guilt or innocence during these examinations.

Lastly, the most recent advances have called for anesthesiological modification of the stages of narcosis required for proper interrogation. Perhaps the University of Minnesota is on the right path in this approach. Suffice it to say for this discussion, now various cerebral stimulants and mollifying agents have been introduced into the anesthetic mixtures. These and other changes allow the anesthesiologist to produce wide fluctuations in the level of mental alterations with greater liberty and in conformation with the decisions of the interrogators.

Research efforts presently called for the investigation of monitoring devices, such as the polyviso and electroencephalograph. These instruments gauge and direct the planes of anesthesia. They also allow us to continue our investigations of such new agents as thorazine, lysergic acid, mescaline, etc. in combination with the basic anesthetic drugs. Of course, newer methods of administration are also under investigation.

Although I am told the finite theory of narcosis is unexplained, clinical evidence of the anesthetic stages indicates that the various segments of the brain may be selectively depressed in a known order corresponding to their evolutional age, the more recently acquired cortex being depressed first. Psychiatrists generally believe that the cortex performs the discriminatory and integrative actions of the personality, while the diencephalon expresses the primitive emotional drives. Thus, in narco-analysis for criminal interrogation, we are concerned only with depression of the cortex and diencephalon, which can be achieved in the first and second stages of general anesthesia. Now, by variation in the level of depression and selective stimulation, combined with proper interrogation techniques, we can modify the personality functions and lead the suspect into known confession mechanisms.

An untold degree of the success achieved by an interrogation team depends upon their thorough knowledge of the confession mechanisms available to the conscious (and thus, the unconscious) suspect. Most of you are aware that the more frequent admissions of guilt come from the criminal's inner desire to compromise with the community. Surely, a little persuasion from friends, relatives, attorneys, and skilled officers helps. Each of these associates helps to soften the emotional conflict of the subject and reduce his fear of punishment. This mechanism is produced easily under narcosis after the perceptive and integrative personality functions are depressed.

Besides this group of delinquents who confess readily, or with little assistance, are the informers and malingerers, the psychopaths, and the addicts, who welcome narco-analysis as an excuse to divulge their knowledge without fear of reprisal by their 'friends'. The knowledge that narco-analysis is available for the solution of cases involving these persons has been of immense value to our local officers.

Narcosis has been used to create, facilitate, or hasten each of the above confession mechanisms by distorting the integrative functions along several pathways. Early in depression there is a reduction of the perceptive apparatus, which also diminishes the response to emotionally unpleasant stimuli, and produces a stage of heightened anxiety, or well-being, according to the ego efforts. At this drug level, skilful questioning may evade the discrimination of the subject and obtain sufficient facts to indicate culpability. Later the drugs attack integration directly, further depress the apprehensive ego, and allow the deepest inhibitions to be released painlessly.

Because this multitude of reactions *is* possible, some evidence of guilt usually escapes even the most hardened, repititious, offenders who feel no remorse. These men have little knowledge of the successful record of the technique, and they consent to the examination because refusal might indicate complicity, or because they believe they can avoid detection and strengthen their case in court. This challenge has been met time and time again by careful manipulation of the psychological and pharmacological levers—by rapidly fluctuating the questioning and drugs to coincide with the mood—and by patient repetition of this process over and over through all the levels of personality and anesthesia. Application of these theories has helped us develop techniques and methods which extract the maximum from our tests.

Technique

There are no 'routines' that can be applied to narco-analysis for criminal interrogation, according to a standard which will insure optimum conditions every time. Each test is a problem in itself. It should be obvious also that one person cannot set himself up as an expert in *all* the phases

of the test without limiting the results. Furthermore, until more research is possible in this field, the techniques we propose to discuss must still be manipulated by trial and error. The degree of precision achieved seems to depend largely upon the ability of the team members to adapt themselves, by enlargement and contraction of the knowledge applied to the problem, until they strike the proper balance in time and subject. However, certain practicalities have emerged as a result of accumulated experience. Perhaps these can be described best by recounting the process we now follow in an ideal case—where all our intentions can be translated into action.

When it becomes evident that narco-analysis for interrogation of a given suspect is possible, the proper team of consultants is drawn from the campus and the community. These individuals must be selected on the basis of (1) their scientific objectivity—for we do not have time under anesthesia to permit prejudice and lack of flexibility by the questioners to defeat the purpose—and (2) for whatever specific contribution they can lend to the actual interrogation. For example, on different occasions we have been benefited by the presence of lawyers for defence and prosecution, judges, psychiatrists, psychologists, foreign language experts, laboratory scientists and various investigating officers. Those who are most familiar with the personality of the suspect and the details of the crime constitute the nucleus of the interrogation team. We always select an *anesthesiologist* for the drug administration because of his obvious knowledge of the pharmacology, limitations of the various agents required, and the levels of anesthesia sought during the test. His presence and the patient-physician relationship protects the patient medically and contributes something to the patient's emotional well-being.

In the initial interview the principal interrogator attempts to establish rapport with the suspect, convinces him of our impartiality and fairness, and heightens his confidence in a fair examination. We usually conduct several preliminary psychological tests to establish a more scientific basis of our knowledge of his personality, intelligence and emotional stability. The interview concludes when the suspect definitely understands his constitutional liberties, which allow him to refuse the examination or accept the possibility that its results might be used in subsequent investigations or prosecution.

The actual narco-analysis is conducted in an operating room suite. Although it is difficult to avoid the apprehension created by this location, the safety and convenience to the patient and physician are more important. Every effort is made to alter the furniture, etc., to create a better atmosphere. A thorough physical examination and medical history are evaluated by the anesthesiologist—just as he does for routine surgical anesthesia. The suspects seem to derive additional comfort from this precaution, too.

Pre-anaesthetic medication with intravenous barbiturates, scopolamine and

occasionally morphine, is just as essential for these examinations as it is for surgery. The dosage of scopolamine is increased slightly, but otherwise the quantities required for routine anaesthetic premedication are used. Basal narcosis is accomplished with a 2½% concentration of sodium pentothal. All the medication is given intravenously because of the rapid onset of effect and easy control achieved. The sodium pentothal is injected gradually as we converse with the suspect about anything *but* the crime. As the first stage of anaesthesia is passed and the suspect finds it more and more difficult to hear and answer our questions, the conversation is changed to more critical events. At this stage he may repeat the same story he told before anaesthesia. With some persuasion, as we described in the theoretical discussion, he may begin his confession. Usually it is first necessary to traverse the whole first and second stages of anaesthesia before incriminating information is released. The interrogation is varied, just as the anaesthesia is deepened and lightened, according to the decisions to attempt an emotional outburst, or to confuse the orderly thinking of the suspect.

Most of our confessions have followed reactions of fear, extreme anger, boasting, love, etc. Once the admission of guilt is begun, we attempt to hold the suspect on the same train of thought, and bring him slowly out of the anaesthetic until we have a clear, intelligible record of the entire confession on a tape recorder. Occasionally picrotoxin, metrozol, benzedrine and thorazine have been used to accentuate certain of the responses. More experience will be necessary with these drugs to outline the precise role they play in the interview.

The post-anaesthetic interview offers the team an excellent opportunity to confront the suspect with recordings of his guilty knowledge. When properly presented to him, this surprise often produces an admissible extra-judicial confession. Reviews of the tape recordings also frequently suggest new avenues for police investigation.

Not all interviews end in confessions, of course. We are quite proud to say that *most* of our suspects were innocent. Their general conduct, eagerness to assist the interrogators explain their questionable actions, and their complete freedom from evasion helped persuade the referring officers to look elsewhere for their criminal.

Unsuccessful results probably come from a failure to apply the principles outlined here. Undoubtedly low intelligence contributes to the difficulties encountered and wears the patience of the team. Acts committed during profound alcoholic stupor and associated with severe head wounds probably are not accessible through this means. Prolonged incarceration and violent treatment or severe questioning reduce our ease of interrogation and may, at some future date, negate our efforts.

No reports have been discovered to the effect that narco-analysis for criminal interrogation has been used to force a suspect to confess a crime he did not commit. On the other hand, guilty suspects have maintained

their lies during tests by methods other than we have described here. Perhaps our statistical group is still too small, and we may soon encounter a failure. Nevertheless, until the test is more fully developed, and more accurately measured, the suspects' drug-influenced statements must be corroborated by fact before they can be admitted as evidence.

Whereas there is a great divergence of opinion about the need for legalizing these tests, we ought to conclude with a summary of our thoughts on this aspect:

1. We have shown that the test *is* capable of application to all types of cases—adaptable to all kinds of personalities.

2. Although the truth has been accessible in our limited experience, the suspects can still lie and thwart the examiners.

3. It, therefore, remains with sufficient inaccuracy to advise against admission as evidence on this basis alone.

4. The drug-induced statements must be corroborated by facts before they can serve defence or prosecution in court.

Therein lies the primary purpose of our tests. Ethically, it is far superior to third degree methods which employ physical or mental coercion. It frequently provides a rapid avenue to justice, which I am sure all of you can appreciate. The methods described are not intended to supplant accepted modes of investigation; rather, success seems proportioned to the quality of the investigation which precedes the narcosis. Lastly, narco-analysis is a delicate, prolonged operation, which should be available to any person who may benefit from it. But it should never be used without good reason.

I find it impossible to close without paying tribute to our anaesthesiologist, Dr. James Matthews. Without his untiring efforts, knowledge and inspiration, our investigations of this technique would not have been possible. Those of you who are more interested in the precise details of both the drug and the interrogative process should consult the basic references outlined in the *Textbook of Legal Medicine*, edited by Dr. Gradwohl, wherein Dr. Matthews has summarized our findings.

Trauma and Intracranial Tumors*

With Particular Reference to the Gliomas

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Occasionally, there is exposed at the autopsy table a brain which is the seat of a glioma. When in such a case there is also a history of a recent injury to the head, the question may arise whether the tumor was not a direct consequence of the craniocerebral injury. If such is actually the case, the victim's family may be entitled to industrial compensation or an insurance award. This is certainly true if the circumstances in which the injury occurred showed that the affected person was regularly engaged at his employment or if trauma took place as the result of someone's carelessness. This is the medicolegal problem which confronts the pathologist in this situation, for he it is who is often obliged to give his opinion about the possible relation between the injury and the development of the tumor.

This question is not new. Some 2 decades ago, Marburg[1] wrote a small monograph on this subject, which reflected essentially the opinion of German writers to his time. He concluded that intracranial tumors could arise as a consequence of a craniocerebral trauma and in individual cases could be considered as the actual and direct effect of injury. With this conclusion, Harris[2] seemed to be in agreement. Opinion of other students of the problem, however, appears to be contrary to this assumption, for a critical analysis of the clinical record in view of the nature and location of the tumor usually fails to be very convincing.[3,4] This study therefore constitutes a re-investigation of the problem in the light of a series of cases which have come to the attention of the present writer, being selected from a total series of over 2,000 instances of verified intracranial tumors. These cases have been critically analyzed with respect to the mechanism of the injury in the light of the present writer's previous investigations on the subject.[5,7]

Essential Postulates

There are certain criteria which must be fulfilled in a given case if one is to assume reasonably that an intracranial tumor is the direct consequence of a specific episode of trauma to the head. These postulates are not unlike those set up to establish the relationship between trauma and tumor formation in other regions of the body. They may be listed as follows:

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(1) The tumor must arise at the precise point of the impact, or in the case of intracranial tumors, at a point known to be susceptible to damage by the particular mechanism by which the injury was sustained;

(2) The injury must be of a degree of severity sufficient to warrant the conclusion that the brain as well as the scalp and the skull have been injured; and

(3) A sufficient interval of time must have elapsed between trauma and the first signs of the tumor to permit its assumed average maturity.

Obviously, it must be certain that no symptoms traceable to the presence of the growth antedated the injury. By these 3 criteria all cases should be judged. Unless all of them are adequately applicable, there is good reason to doubt that there exists any causal relationship between the injury and the development of the tumor.

Trauma and Intracranial Tumors in General

The present writer has recently reviewed the possible relationships between some other primary tumors (neurofibromas, meningiomas, etc.) of the intracranial space and the matter of injury[8] and this phase of the problem need not be considered again. It will be sufficient to say that in the case of the so-called acoustic neurofibromas, this relationship has been suspected in some individual instances. Cushing[9] has pointed out that in some cases this type of new growth arises months or years after a fall on the back of the head, the impact being sustained on the side of the development of the tumor. Meningiomas may also develop at the point of impact, again after a period of months or years, an interval theoretically sufficient to permit the growth of this usually benign tumor.[10] The classical case reported by Penfield[11] seems to be one in point. In this instance grains of coal dust were found imbedded in the base of the tumor which evidentally grew as the direct result of an injury to the skull, sustained when a lump of coal struck the individual on the vertex.

In this connection specific attention will be directed to that group of tumors (the gliomas) arising from the tissues of the nervous system proper. It was observed that among the dozen or more possible varieties of gliomas, the more malignant form of glioma, commonly known as the glioblastoma multiforme, was often considered as a possible effect of injury. The benign ones (astrocytomas, etc.), however, are by no means to be excluded. This problem will be probed from 3 possible angles:

(1) The possibility of the development of a glioma as viewed from the nature, severity and location of the injury;

(2) The relation of presumed post-traumatic symptoms with respect to the presence of the tumor; and

(3) The essential pathology of residual post-traumatic lesions in general, and of the common malignant gliomas in particular.

An Analysis of the Traumatic Episode

According to the first postulate, there should be some very close and significant relationship between the mechanics of injury and the location of the tumor if one is to accept the injury as a causal factor. It is now recognized that there are 2 essential mechanisms of craniocerebral injury. The first mechanism is that in which the traumatizing object in motion strikes the quiescent or relatively quiescent head. The second mechanism comes into play when the moving head comes in contact with some resting or relatively quiescent object. In the first case, any injury to the brain must occur at the point of impact and can result only if the integrity of the overlying cranial vault has been violated. In the second case, it is possible for the enclosed brain in motion to be thrust against the irregular bony eminences in the anterior and middle fossae of the skull, resulting in some instances in relatively distant lesions (*contrecoup* contusions). In either case, it must be assumed that if the tumor actually results from a specific injury, it should grow at a point where, on the basis of the specific mechanism involved, the cerebral damage must have been sustained. If indeed the tumor is found in a different portion of the brain, or perchance the trauma was not of sufficient severity to injure the brain through an intact skull, it must be assumed that there can be no relation between the injury and the growth of the glioma.

Evidence from the Clinical History

From a survey of the 22 cases investigated by the present writer, it was usually the rather prompt post-traumatic development of specific symptoms which ultimately proved to be due to the presence of the glioma that brought up the question about a possible relationship between the two. As a rule, the acute manifestations which followed the traumatic episode did not clear up entirely, but merged more or less directly with those provoked by the tumor. It is not, therefore, unreasonable for the lay or legal mind to assume that the cranial injury was the immediate and direct cause of the development of the tumor. The serious defect in this reasoning lies in the fact that it takes considerable time for even a malignant glioma to become large enough to cause symptoms, either those of localizing character or those indicative of an increased intracranial pressure. This is a matter of months if not years.* It must be assumed, therefore, that the traumatic episode usually serves only to bring into sharp focus the presence of the

* The verity of this deduction is suggested by the case cited by Cushing to the effect that epileptic seizures were present for *eight years* in a man who ultimately proved to have a glioblastoma multiforme in the motor area. In this instance the proximity of the growth to the motor centers caused early convulsive symptoms. The present writer assumes that this is a most unusual situation and that ordinarily the growth of a malignant glioma is to be measured in months rather than years. On the other hand, when the so-called silent areas are involved, no symptoms may occur until shortly before a crisis is precipitated by an increase in intracranial pressure.

glioma. This acute development of symptoms, common even without trauma, is usually considered to be the result of some circulatory disturbance in the vicinity of the tumor. Because it is very doubtful that trauma actually shortens life to any appreciable degree in these circumstances, it is difficult to see that such individuals or their heirs are entitled on this basis to any material compensation or award.

Contribution of Pathology

It has already been pointed out that the specific type of glioma present in most of these instances has, in the writer's experience, been of a malignant variety (17 of 22 instances). This seems to account for their rapid clinical evolution once the resultant symptoms have made their appearance. But the very fact that the tumor is malignant appeals to the untrained mind as proof positive that the injury was the actual cause of 'cancer of the brain'. The fallacy of this assumption has already been pointed out. However, the possible causal relation between a specific injury and the development of a benign glioma may present even greater difficulties.

There is still another contribution which a critical study of the neoplasm itself may make to a solution of this problem, and this should not be overlooked. The brain is not infrequently the seat of traumatic lesions of the brain, both as a result of direct and contrecoup injury. The pathologist not infrequently observes the residual yellowish cortical defects consequent to 'closed injuries' in the subfrontal and anterior temporal regions, or occasionally cortical defects elsewhere which are residual to local depressed fractures or penetrating wounds. But in no verified case has there ever been observed the development of a true glioma in one of these scars.*

A final point remains to be made. A reasonably critical study of a number of these cases of 'traumatic glioma' by the present writer has shown nothing which could be imagined to be of traumatic etiology, either in the immediate environs of the tumor or elsewhere. This, of course, was really to be expected, for as a rule the trauma was of such mild degree that no traumatic intracranial lesions were to be expected.

The data upon which this survey was made will be found in Tables I and II. In Table I the cases of verified glioma are listed but in which the exact location of the injury to the head and its mechanism are unknown. This leaves a serious doubt about the relation between the two in any circumstances. In Table II are listed the cases in which the precise location of the injury and the mechanism of its application are known. Other

* In his well-known text on cranial surgery, Rawling,[1] described what he considered to be a glioma in the borders of an old laceration of the cerebral cortex and subcortex. The present writer understands that a review of the slides from this scar by Percival Bailey showed that what Rawling considered to be a glioma was simply a regional scar. This was a natural mistake in that day when relatively little was known about the differentiation of an astrocytoma from a local reactive astroglial proliferation.

Table I: Trauma and Gliomas—Injury to Head of Unknown Mechanism

Case No.	*Age & Sex*	*Interval Between Trauma & Symptoms*	*Essential Symptoms*	*Location of Glioma Verified at Autopsy*	*Argument Against Traumatic Etiology of Tumor*
1	30 Male NC #5	1. Two years—dislocated shoulder. 2. Few days—struck head on stove, death in one week.	Generalized convulsions with left lateralization.	Right frontal lobe (astrocytoma).	Old injury apparently did not involve head to any appreciable degree; recent head injury leaves too short a survival time.
2	5 Male NC #189	Fell 8 months before death, striking head on sidewalk; location of point of impact unknown.	Anorexia and nausea, 8 months; ataxia, 3 months; double vision, 3 weeks.	Cerebellar vermis (medulloblastoma).	Symptoms began almost immediately following injury; not enough time for tumor to grow.
3	47 Male NC #462	Struck on head during a hold-up 6 months before death. Symptoms began 6 weeks after injury.	Progressive weakness, left side; progressive impaired vision.	Huge malignant glioma (glioblastoma multiforme) of corpus callosum and both frontal lobes, mostly right-sided.	Symptoms began too soon after injury to permit development of glioma and invasion of motor system.
4	51 Male CC #107	Beaten about head and body in strike, 13½ months before death.	Nervousness and dizziness since accident. Impaired vision and severe headaches, 1½ months before death.	Malignant glioma (glioblastoma multiforme) of splenium of corpus callosum extending into both occipital lobes.	Uncertain relationship of minor symptoms immediately following injury to location of tumor; no definite localizing signs.

Table I: Trauma and Gliomas—Injury to Head of Unknown Mechanism—*Continued*

Table I: Trauma and Gliomas—Injury to Head of Unknown Mechanism—*Continued*

Case No.	*Age & Sex*	*Interval Between Trauma & Symptoms*	*Essential Symptoms*	*Location of Glioma Verified at Autopsy*	*Argument Against Traumatic Etiology of Tumor*
5	60 Male CC #119	Knocked down by passing auto, 2½ months before death; evidently minor head injury.		Malignant glioma (glioblastoma multiforme) of genu of corpus callosum extending into both frontal lobes.	Entire survival period too short for development of large tumor found at autopsy.
6	32 Male CC #501	Blow on head 6 months before death; symptoms began immediately after injury.	Headaches, progressive left faciobrachial weakness; personality changes for 6 months.	Malignant glioma (giant cell glioma, probably transitional) of right thalamus with internal hydrocephalus.	Symptoms finally recognized to be due to tumor began immediately after injury.
7	Adult Fe CC #526	Injury to left shoulder with uncertain injuries to head, 5½ months before death; symptoms began shortly after injury. Suspect subdural hematoma.	Progressive weakness of left extremities.	Small gliomatous cyst (astroblastoma) right temporal lobe.	Injury to head evidently too minor to be seriously considered as etiological factor. Interval between injury and symptoms also too short.
8	40 Male CC #58	Injury to head (minor) in auto accident, 6 months before death.	Acute psychosis immediately following accident. Lethargy. Temporary improvement following surgery.	Huge malignant glioma (glioblastoma multiforme) of genu of corpus callosum extending into both frontal lobes.	Injury evidently provoked severe psychotic episode. Total survival period too short for growth of tumor.
9	42 Male CC #792	Cerebral concussion due to auto accident 5 weeks before death.	Sudden onset of psychotic symptoms after auto accident.	Multiple gliomas (glioblastoma multiforme) of corpus callosum, corpus striatum and right and left frontal lobes.	Interval between injury and symptoms incident to tumors too short; injury to head relatively minor.

Table II: Trauma and Gliomas—Injury to Head of Known Mechanism

Case No.	*Age & Sex*	*Nature & Location of Injury*	*Interval Between Injury & Symptoms*	*Location of Glioma*	*Relation of Location of Glioma to Seat of Injury*
1	26 Male CC #5	Fall from scaffold with impact on *right side of head.* Fracture of right temporal bone.	Onset right sided convulsions 3½ months after injury followed by right hemiparesis. Death 20 months after accident.	Cystic glioma (astrocytoma) left frontoparietal region.	1. Tumor too high in hemisphere and too far forward from anticipated point of injury. 2. Injury severe enough (skull fracture). 3. Interval too short to cause tumor.
2	32 Male CC #28	Fell, striking head *right frontotemporal region.* Not rendered unconscious; did not stop work.	Onset convulsions, 2 days after injury. Onset headaches, 1 year later. Death 14½ months after injury.	Gliomatous cyst (astrocytoma with malignant change) right frontotemporal region.	1. Mechanism in this case corresponds closely to anticipated site of injury. 2. Injury not severe enough to produce the tumor. 3. Symptoms came on too soon to account for tumor arising consequent to injury.
3	50 Male CC #34	Struck by automobile while crossing street with impact in right temporal region. Linear fracture right middle fossa of skull.	Death 4 hours after accident. (No history of symptoms from tumor but suspect left homonymous hemianopia).	Malignant glioma (glioblastoma multiforme) with central softening, posterior portion left temporal lobe.	Short interval precludes any relationship between injury and genesis of glioma. Even had patient survived, tumor in wrong location.

Table II: Trauma and Gliomas—Injury to Head of Known Mechanism—*Continued*

Table II: Trauma and Gliomas—Injury to Head of Known Mechanism—*Continued*

Case No.	*Age & Sex*	*Nature & Location of Injury*	*Interval Between Injury & Symptoms*	*Location of Glioma*	*Relation of Location of Glioma to Seat of Injury*
4	43 Male CC #112	Struck on right occipital region of head by falling ladder—not unconscious. No fracture of skull.	Symptoms began same day as accident with subsequent rapid progression right sided symptoms. Death 8 months after original injury.	Huge malignant glioma (glioblastoma) protruding with cerebral hernia thru surgical defect.	1. Onset of specific tumor symptoms immediately after accident precludes any relationship between trauma and tumor. 2. Lesion, if any, should have been *occipital*, not parietal. 3. Absence of local skull injury precludes any injury of brain.
5	63 Male CC #158	Injury to top of head while raising up underneath a cross beam.	Symptoms began next day after accident. Headaches and psychic disturbances, dizziness and loss of coordination soon followed. Weakness left arm and leg. Death 5 months after injury.	Gliomatous cyst (glioblastoma multiforme) right side of splenium of corpus callosum extending into right parieto-occipital region.	1. Symptoms began at once after accident. 2. Tumor assymetrical in area not affected by vertical blows. 3. Injury not severe enough to account for the tumor. 4. Impact at vertex. Lesion should be adjacent and symmetrical.
6	50 Male CC #307	Injury to back of head while working under a truck.	Death 3½ months after injury. Onset symptoms 3 weeks after injury. Headaches, nausea, vomiting and progressive failure of vision.	Multiple malignant glioma (glioblastoma multiforme) of splenium of corpus callosum with invasion of regional structures. Incidental small meningioma of posterior fossa.	1. Interval entirely too short for any cause-effect relation between tumor and injury. 2. Injury to brain, if any, to occipital pole not corpus callosum.

Table II: Trauma and Gliomas— Injury to Head of Known Mechanisim—*Continued*

Case No.	*Age & Sex*	*Nature & Location of Injury*	*Interval Between Injury & Symptoms*	*Location of Glioma*	*Relation of Location of Glioma to Seat of Injury*
7	56 Fe CC #620	Fall with focal abrasion right parieto-occipital region.	Symptoms developed an uncertain length of time after injury, probably within 3 months.	Hemorrhagic malignant glioma (glioblastoma multiforme) of right temporal lobe.	1. Interval after trauma suggests possible cause relation to tumor. 2. Tumor found in wrong temporal lobe with respect to anticipated injury.
8	62 Male CC #705	Injury to right side when thrown against a brace of truck.	Immediate onset of dizziness and blurred vision. Survived 10 weeks with death after operation.	Malignant glioma (glioblastoma multiforme) of corpus callosum extending into right frontal lobe.	1. Onset of symptoms too soon after impact of injury. 2. Tumor in wrong location with respect to anticipated injury. 3. Injury not severe enough to produce cerebral damage.
9	44 Male CC #714	Fell at work, striking head in left parieto-occipital region.	Uncertain history. Patient said he developed left hemiparesis immediately after injury, then that it occurred 5 to 6 weeks later. Developed signs of increased intracranial pressure.	Malignant glioma (glioblastoma multiforme) right parietal lobe with extension into ventricles.	1. Interval too short—6 months between injury and death. 4 to 6 weeks at most between injury and first symptoms. 2. Tumor in wrong place re: history of injury.
10	47 Male NC #466	Struck by auto. Knocked to pavement with injury to right frontal and parietal regions.	No residual symptoms of injury. Death 6 years and 3 months later.	Malignant gliomas (glioblastoma multiforme): (1) Right temporo-occipital region and (2) Right temporal centrum.	1. Interval rather long between injury and discovery of tumor. 2. Lesion in wrong place for anticipated trauma (no gross lesion found). 3. Severity of injury adequate.

Table II: Trauma and Gliomans—Injury to Head of Known Mechanisim—*Continued*

Case No.	*Age & Sex*	*Nature & Location of Injury*	*Interval Between Injury & Symptoms*	*Location of Glioma*	*Relation of Location of Glioma to Seat of Injury*
11	Adult Male NC #533	Struck on top of head by falling cellar door.	Death 2 months after injury. Signs of increased intracranial pressure. Frontal lobe manifestations.	Cystic malignant glioma (glioblastoma multiforme) right frontal lobe.	1. Interval too short for development of large cystic tumor. 2. Tumor in wrong place. 3. Injury not severe enough.
12	48 Male NC #818	Fell 2 feet from wall sustaining laceration of left eyebrow, left parietal skull fracture and aphasia.	Accentuation of aphasia and right-sided convulsive seizures 2 months after injury. Progressive stupor. Death 5 months after injury.	Hemorrhagic malignant glioma (glioblastoma multiforme) left temporo-parietal region.	1. Interval too short for development of glioma. 2. Confusing factor post-traumatic aphasia later recurrent with tumor, probably accentuation of tumor effect. 3. Trauma probably adequate enough. 4. Tumor in wrong location as compared to focus of anticipated injury.
13	66 Fe 52–494	Struck on forehead with lead pipe a few weeks prior to onset of symptoms. No immediate residuals.	Onset of symptoms about 3 weeks after injury. Convulsions, coma and right hemiplegia. Death 3½ months after injury.	Malignant gliomas (glioblastomas) in both temporo-occipital regions.	1. Injury not severe enough to produce damage to skull or brain. 2. Mechanism would demand tumor in frontal, not temporo-occipital region. 3. Interval between injury and onset of symptoms too short.

details such as the location and nature of the glioma, and the interval of time which elapsed between the injury and the onset of symptoms incident to the tumor are also given. The total survival period after the onset of these symptoms is also recorded. This evidence seems to make decisive the conclusion that trauma to the head is not the cause of gliomas, insofar as contemporary experience would seem to indicate.

Summary and Conclusions

This study is based upon the clinical and pathological observations in a series of 22 cases in which the appearance of symptoms following a relatively minor injury to the head led to the assumption that this injury was the actual cause of a glioma (glioblastoma multiforme most commonly) of the brain found at autopsy. That this was not actually the case seems proven, not only by the fact that the injury was usually not of a sufficient degree to cause any appreciable intracranial damage, but also because the location of the glioma was such as to preclude any connection with the injury. Moreover, the time interval between the injury and the onset of symptoms secondary to the tumor was usually too short to allow for the growth of a glioma, even a malignant one. The failure to discover a *bona fide* case of glioma developing in a traumatic scar and the absence of any signs of trauma to the tissues of the brain, either in the environs of the tumor or at a distance, would further suggest that gliomas are probably never the direct consequence of craniocerebral trauma.

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The Human Sternum

The Influence of Sex and Age on Its Measurements

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Since the time of Eustachius, classical illustrations and descriptions of the human sternum (Valverde (1589), Vidius (1611), Winslow (1756), Monro (primus) (1758), Duverney (1761), Quain (11th Ed.)), have indicated in a general way the shape which applies to this bone in the majority (say 70%) of persons. However, it is perhaps not generally recognized that marked variation from the 'normal' form can be demonstrated in the remaining 30% of specimens. A study of the literature reveals that certain points of controversy still exist concerning the true significance of variability in the shape of the mesosternum. One of the major controversies concerns the influence of sex on the size and proportions of the sternum.

Literature

Wenzel (1788) studied 200 sterna and was the first to remark on a difference which exists betwen male and female sterna. This difference concerns the ratio between manubrial length and mesosternal length. Feigel (1837) in his *Handbook of Anatomy* repeated this assertion: 'Beim Weibe der Handhabe zum Körper ist grösser als 1 : 2, kleiner als desselbe hungegen beim Manne'. Hyrtl (1853) popularized this idea in his textbook, and since then certain anatomists (e.g. Dwight 1908) have referred, unjustifiably, to the conception as 'Hyrtl's Law'. Krause (1897) drew attention to the real author of the 'Law' but was unable to support the view expressed. Strauch (1881), Dwight (1890), Petermoller (1890) and Bogusat (1902) all carried out special investigations on the sternum and, whilst confirming the general truth of Hyrtl's law, they found that there were many exceptions. Petermoller made the suggestion that the shortened sternum of females might be due to the prevailing habit of wearing tight clothing and bodices. This idea seems hardly tenable, particularly in view of Schultz' finding (1941, 1944) that Hyrtl's law is as applicable to the orang-utan and the gibbon as it is to man.

Despite the investigations above reported, no better rule was forthcoming for differentiating male from female sterna, and the rule is still adhered to in the most recent editions of some anatomical text-books (Quain, 11th Ed.; Morris 5th Ed.; Cunningham, 9th Ed.; Frazer, 4th Ed.). Another point of difference was remarked on by Paterson (1904) who states: 'In the female, the mesosternum is often extremely broad in the lower part, so as to give rise to a "type" of sternum, which can almost be designated the "female" type; although it must be admitted that this type is not infrequently found in male sterna as well'. He attributed no statistical value to this finding.

Numerous observers have sought to establish a relationship between the length–breadth ratio of the sternum and the *sex, bodily habitus,* or *race* of the subject. A major omission has been the failure of any observer to investigate in detail the influence of *age* on the dimensions of the sternum, although Paterson made some observations on this point.

Strauch studied 200 specimens and related absolute measurements to sex. He found that on average the male mesosternum is 2 cm. longer than the female (11 cm. and 9 cm. respectively). Dwight confirmed this and also related the combined length of manubrium and mesosternum to body height. He found that the length of the sternum provides a useful guide to the height of the individual.

Krause, utilizing figures prepared by Strauch, derived information which, again, showed some relation between sternal length and body height.

Testut stated (1889): 'le sternum de la femme est généralement moins large et plus long (*sic*) que celui de l'homme'. This fallacious statement was apparently plagiarized by Debierre (1890), and by Gegenbauer (1892), the latter stating: '. . . beim Weibe . . . der Körper langer und schmäler als beim Manne ist'.

However, the opinion of most observers is that the male sternum is considerably longer than the female and that the difference in length lies mainly in the mesosternal portion of the bone (Dwight, Strauch, Petermoller, Bogusat, Quain, Paterson, also Merkel (1899) and van Gelderen (1924)). At the same time, it should be noted that absolute measurements have never been used, in a statistically valuable form, as a differentiating feature separating male from female sterna.

From the literature quoted one may draw the following conclusion:

As a means of determining the sex of an isolated sternum, 'Hyrtl's Law' is of very dubious value, but as yet no better law has been devised.

Research Undertaken

I have determined absolute and relative measurements of the manubrium and mesosternum in a large series of human sterna to ascertain the influence of sex and age on the shape of this bone. The series includes 98 East African and 573 European adult sterna.

Method of Study

The measurements taken are indicated in Fig. 1A. All measurements are recorded to the nearest millimetre. From these measurements the following proportions were ascertained:

The Manubrium-Corpus Index, i.e.

$$\text{Manubrial length as a percentage of mesosternal length} = \frac{M \times 100}{B}.$$

The Mesosternal Relative Width Index, i.e.

Width of first mesosternal segment as a percentage of width of third mesosternal segment $= \frac{S_1 \times 100}{S_3}$.

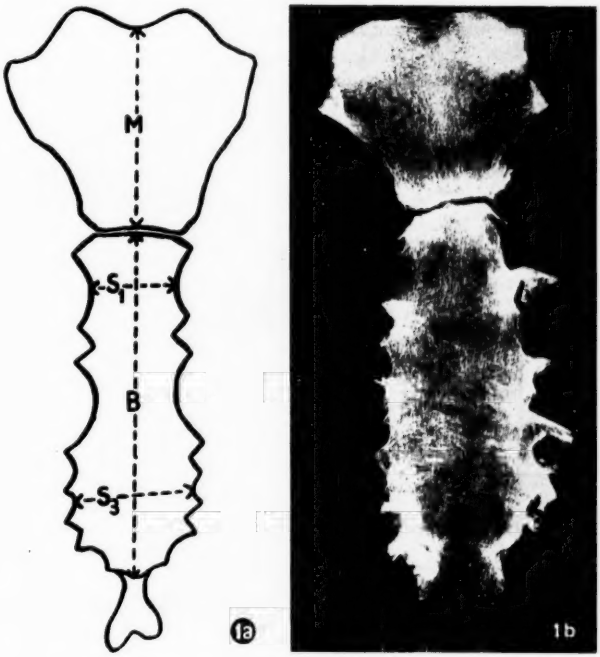


Fig. 1*A*. M = length of manubrium in mid-line. B = greatest length of body of sternum (i.e. mesosternum). S_1 = width at waist of first segment of mesosternum. S_3 = width at waist of third segment of mesosternum.

Fig. 1*B*. Radiograph ($\times \frac{1}{2}$) of a sternum from a male aged 75 to show exaggerated costal processes due to perichondral ossification of costal cartilages*.

* In measuring the widths of segments 1 and 3 the measurements were taken at the 'waist' of each segment in preference to the maximum widths as advocated by Martin (1914). Maximum widths are sometimes obscured by the exaggerated costal processes which are frequently seen in aged specimens (see 1B above).

Findings

Findings are listed under the following headings:

I Absolute measurements of adult sterna:
- (a) in Europeans;
- (b) in East Africans.

II Relative measurements of adult sterna:
- i. Paterson's 'female' type in Europeans;
- ii. 'Hyrtl's Law' in Europeans and East Africans.

III Suggested new 'rules' for differentiating male from female sterna:
- (a) for Europeans—the '149 Rule';
- (b) for East Africans—the '136 Rule'.

IV Continuing growth of the sternum after *aet.* 20.

V Effect of such continuing growth on the applicability of the '149 Rule' (in Europeans).

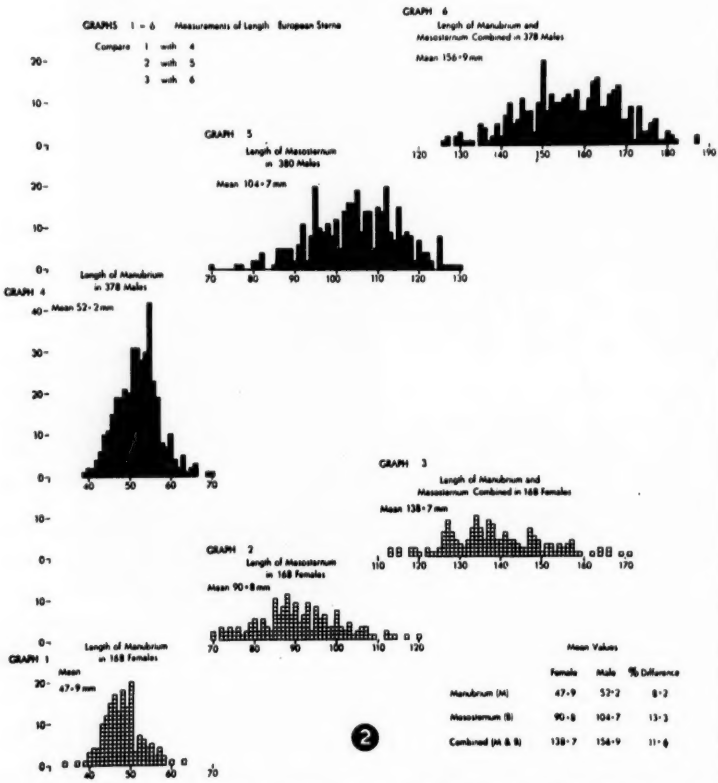

GRAPHS 1 – 6 Measurements of Length European Sterna
Compare 1 with 4
2 with 5
3 with 6
GRAPH 6
Length of Manubrium and Mesosternum Combined in 378 Males
Mean 156·9 mm
GRAPH 5
Length of Mesosternum in 380 Males
Mean 104·7 mm
GRAPH 4
Length of Manubrium in 378 Males
Mean 52·2 mm
GRAPH 3
Length of Manubrium and Mesosternum Combined in 168 Females
Mean 138·7 mm
GRAPH 2
Length of Mesosternum in 168 Females
Mean 90·8 mm
GRAPH 1
Length of Manubrium in 168 Females
Mean 47·9 mm
Mean Values
Female Male % Difference
Manubrium (M) 47·9 52·2 8·2
Mesosternum (S) 90·8 104·7 13·3
Combined (M & S) 138·7 156·9 11·6
2

Fig. 2. Graphs 1—6 indicate the wide range in the lengths of both male and female sterna, and the percentage differences between the male and female average values.

I. Absolute Measurements of Adult Sterna

Note: In order to conform with the method of age-grouping adopted by previous workers (Trotter, Pässler, van Gelderen), sterna from individuals aged 20 years are included in the 'adult' series.

(a) *European Sterna.* This group consisted of 399 male and 174 female specimens, all of known age. In a few of the specimens one or other part of the bone was damaged, so there is slight variability in the numbers of observations of the different measurements.

The range and frequency-distribution of length and width measurements of European sterna are shown in Fig. 2 (Graphs 1–6 concerning lengths) and Fig. 3 (Graphs 7–10 concerning widths).

The range and averages of these measurements of length and width are summarized in Table 1, which also indicates absolute and percentage differences between female and male average values.

(b) *East African Sterna.* The 118 East African sterna examined were in the Galloway collection at Makerere College, Uganda, and included specimens from at least 20 different East African tribes, some of Bantu and others of Nilotic stock. The sex was known, but in some instances the age could only be guessed at from the condition of the epiphyses of the long bones and the state of the teeth. Ninety-eight of these specimens were known or considered to be from individuals aged 20 or more, but a few of these may have been from 18- or 19-year-olds. In view of the smallness of the series no attempt is made to divide the African sterna into 10-year age groups; and these 98 adult specimens are dealt with in one group.

Table I: Absolute Measurements of European Sterna.

Measurement	*Sex*	*No. of Observations*	*Range*	*Average*	*Absolute Difference Between the F & M Averages*	*% Difference between F & M Averages F < M by:*
Length of Manubrium (M)	F	168	34—63	47·9	4·3	8·2%
	M	378	39—70	52·2		
Length of Mesosternum (B)	F	168	70—120	90·8	13·9	13·3%
	M	380	70—130	104·7		
Combined length (M + B)	F	168	113—171	138·7	18·2	11·6%
	M	378	126—187	156·9		
Width at Waist of 1st sternebra (S_1)	F	174	17—41	24·5	1·9	7·2%
	M	399	19—39	26·4		
Width at Waist of 3rd sternebra (S_3)	F	174	19—49	30·5	3·2	9·5%
	M	399	19—52	33·7		

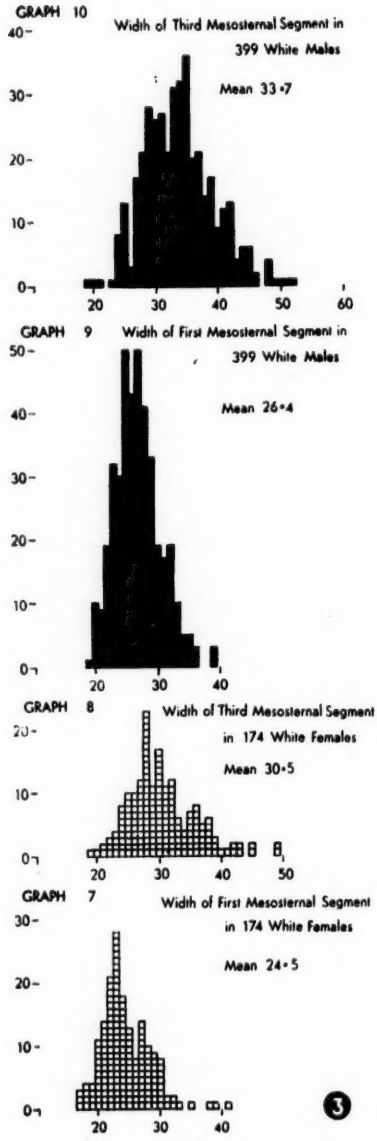


Fig. 3. Graphs 7—10 indicate the differences in the absolute widths of mesosternal segments S_1 and S_3 in males and females.

In Africans, the differences between absolute measurements in male and female specimens are shown in Fig. 4 (Graphs 11–16) and in Table 2.

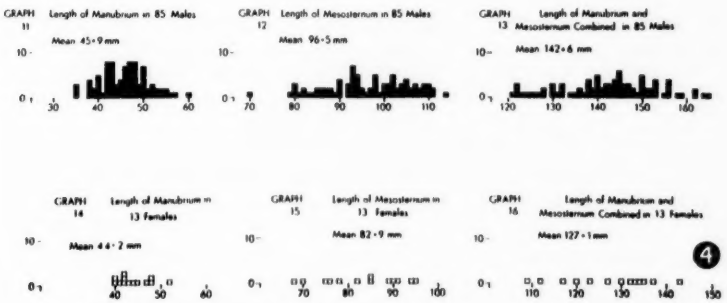


Fig. 4. Absolute measurements of African sterna to show the range and average values in males and females.

Table II: Measurement of African Sterna.

Measurement	*Sex*	*No. of Observations*	*Range*	*Average*	*Difference F < M by:*
M	F	13	40—52	44·2	3·7%
	M	85	35—60	45·9	
B	F	13	68—95	82·9	14·1%
	M	85	70—114	96·5	
M & B combined	F	13	109—143	127·1	10·9%
	M	85	121—165	142·6	
S_1	F	13	17—29	21·5	10·4%
	M	85	19—33	24·0	
S_3	F	13	18—13	26·8	13·3%
	M	85	21—43	30·9	

From Figs. 3 and 4 and Tables 1 and 2 it is obvious that in both Europeans and East Africans the female sternum is absolutely smaller than the male sternum. The greatest percentage difference between male and female values was found in the length of the mesosternum in which the female average value was 13.3% less than the male in Europeans, and 14.1% less in Africans. This finding is in general accord with accepted teaching.

II. Relative Measurements

With regard to relative measurements it is necessary to consider the manubrium–corpus length index in relation to 'Hyrtl's Law', and the

mesosternal relative width index in relation to Paterson's 'female type' of sternum. It will be convenient to consider the relative width index first.

i. *Paterson's 'female type' of sternum and the relative width index—in Europeans.* If a sternum is relatively wide in its lower part then the ratio $\frac{S_1 \times 100}{S_3}$ will be relatively small, and according to Paterson's statement this indicates femininity.

In the series under investigation the relative width index in the 2 sexes has been ascertained and is shown for European male sterna (Graph 17), and for European female sterna (Graph 18) in Fig. 5. It is seen that the mean value of the ratios is only 2.8% less in female than in males. This indicates the general truth of Paterson's statement, but the difference is certainly not striking. It is obvious from the graphs that the range of values in males and females is practically co-extensive. Accordingly this method of differentiating sterna was not given further consideration.

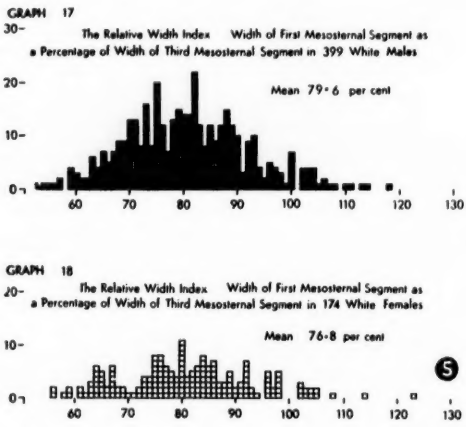
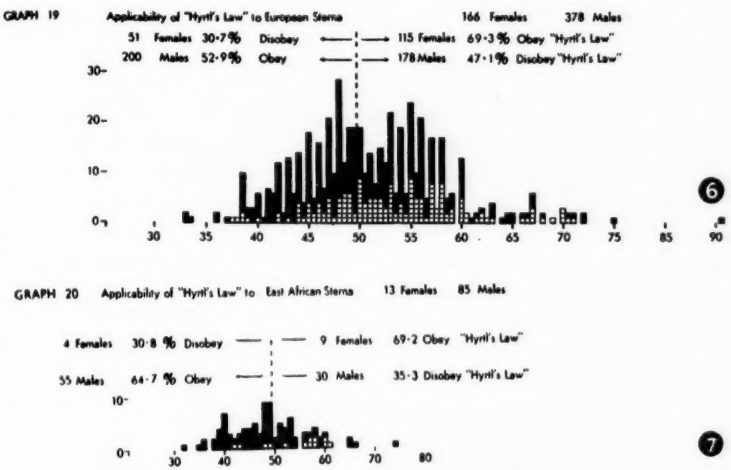


Fig. 5. The mesosternal relative width index in European males and females.

ii. *'Hyrtl's Law' and the manubrium corpus index—in Europeans and East Africans.* The usefulness of 'Hyrtl's Law' was investigated in relation to all sterna from subjects aged 20 years or more. The relationship between length of the manubrium and length of the mesosternum may be expressed either in the form of a simple ratio (e.g. 1 : 2) or as a percentage (e.g. 50%). I have adopted the latter method as thereby the results may be more easily demonstrated in graphic form. To obey 'Hyrtl's Law' the percentage should be 50 or more if the sternum be female and less than 50 if it be male. My findings from European sterna are shown in Fig. 6 (Graph 19) and from African sterna in Fig. 7 (Graph 20).



GRAPH 20
Applicability of "Hyrtl's Law" to East African Sterna
13 Females 85 Males
4 Females 30·8 % Disobey
9 Females 69·2 Obey "Hyrtl's Law"
55 Males 64·7 % Obey
30 Males 35·3 Disobey "Hyrtl's Law"
10
0
30 40 50 60 70 80
7

Fig. 6. The applicability of 'Hyrtl's Law' to European sterna.
Fig. 7. The applicability of 'Hyrtl's Law' to East African sterna.

From these graphs, Table 3 has been prepared to summarize the results of the investigation concerning 'Hyrtl's Law', and at the same time to offer comparison with the findings of previous workers.

Table III: The Applicability of 'Hyrtl's Law'—Various Authors

Observer	*No. of Specimens*	*% Obeying Law*	*% Disobeying Law*
Dwight (1890)	142 Male 86 Female	59·1% 60·4%	40·8% 39·5%
Petermoller (1890)	55 Male 33 Female	*ca.* 65·0%	*ca.* 35·0%
Krause (1897)	14 Female	43·0%	57·0%
Author (African)	85 Male 13 Female	64·7% 69·2%	35·3% 30·8%
Author (European)	378 Male 171 Female	52·9% 69·3%	47·1% 30·7%

From Table 3 it is obvious that 'Hyrtl's Law', is so unreliable as to be of very dubious value from either the medico-legal or the anthropological point of view.

III. Suggested New 'Rules' for Differentiating Male from Female Sterna

(a) *'The 149 Rule'* (*For Europeans*). In view of the findings re 'Hyrtl's Law', I have given further consideration to absolute measurements of male and female sterna, in an effort to discover a more reliable criterion for differentiating male from female sterna.

In Fig. 8 (Graphs 21, 22 and 23) absolute length measurements of male and female sterna are shown in conjunction. In these graphs the position of female values (white squares) can be readily compared with the position of male values (black squares).

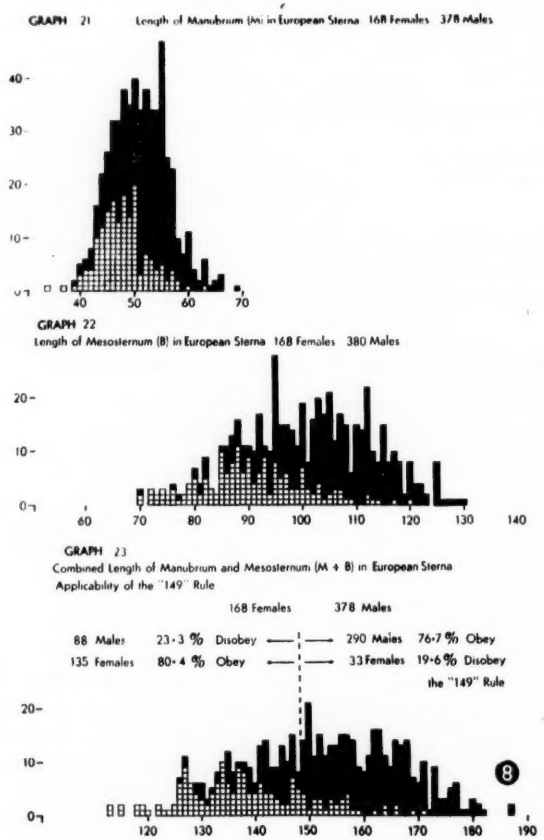


Fig. 8. Graphic demonstration of the significance of absolute measurements in differentiating male from female sterna.

If graphs 21, 22 and 23 are compared it will be observed that in Graph 22 (concerning *mesosternal* lengths of both sexes) there is a relatively greater separation of male and female blocks of values than is apparent in Graph 21 (concerning *manubrial lengths*). The difference between male and female sterna is, however, made even more evident if the combined length of *manubrium and mesosternum* is considered. Graph 23 reveals that with this combined measurement the female and male blocks of values move even further apart. By trial and error I have found that a combined length (M + B) of 149 mm. most nearly marks the dividing line between male and female sterna in Europeans. I have formulated the following 'rule' as a criterion for differentiating between them:

'The 149 Rule.' (*Assuming the state of ossification suggests that the bone is from an adult*): If the combined midline length of manubrium and mesosternum equals or exceeds 149 mm., the sternum is probably masculine, if less than 149 mm., probably feminine.

(b) *'The 136 Rule'* (*For East Africans*): It is emphasized that 'the 149 Rule' applies to adult *European* sterna. For the *East African* sterna examined a '136 Rule' would seem to be applicable, the African sternum being smaller than the European.

The applicability of these 'rules' and 'Hyrtl's Law' to the *same groups of sterna* in Europeans and East Africans is shown, for comparison, in Table 4.

Table IV: Comparison of Findings re Hyrtl's Law and the 149 Rule for Europeans: 136 Rule for East Africans.

Europeans	*Hyrtl's Law Applies to*	*The* 149 *Rule Applies to*
Male (378)	52·9%	76·7%
Female (168)	69·3%	80·4%
Africans	*Hyrtl's Law Applies to*	*The* 136 *Rule Applies to*
Male (85)	64·7%	77·6%
Female (13)	69·2%	84·6%

From this table it is clear that the 'rules' based on absolute measurements are considerably more reliable than 'Hyrtl's Law'.

IV. Continuing Growth of the Sternum after *Aet.* 20

Although an individual is generally considered to have attained his maximum height before the age of 21 (Schultz, 1950), the present investigation

shows that the length and width of the sternum continue to increase throughout life. This observation is illustrated by Graphs 24–27 in Fig. 9, which show the range, frequency and mean of width-measurements in 10-year age groups; and by Table 5, which summarizes the age changes in width and total-length measurements.

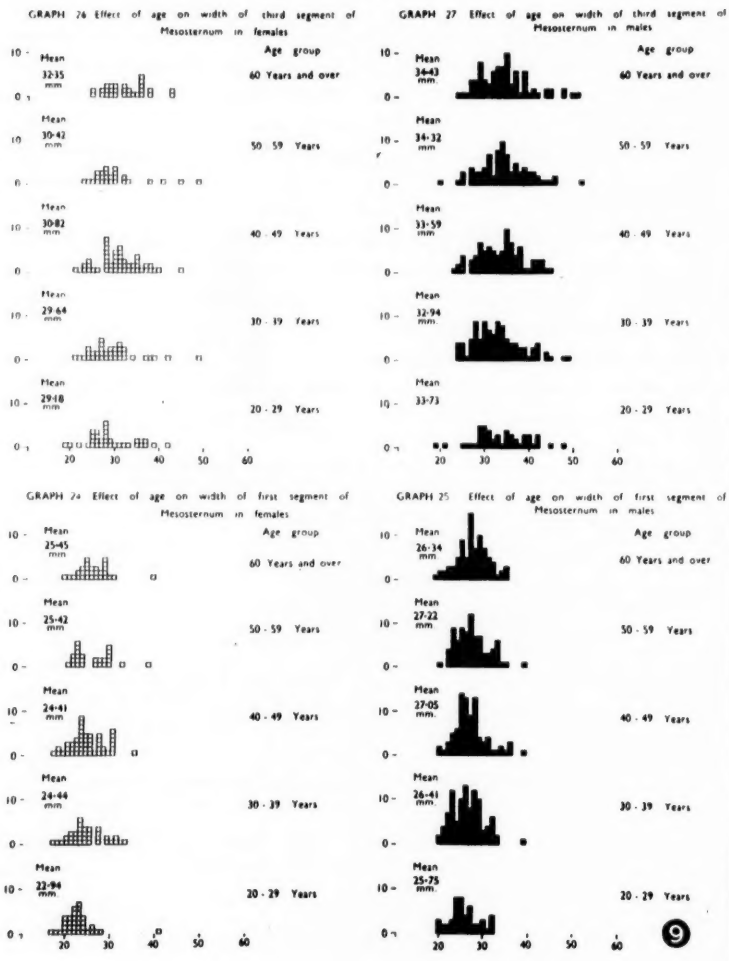


Fig. 9. Graphs to illustrate continuing growth in width of the sternum after the age of 20 years.

Table V: Increase in Growth of the Sternum after the Age of 20.

Measurement	*Age Groups*					*Difference. On Average, the Over 50's are Greater than the Under 40's by*
	Under 40's			*Over 50's*		
	29—29	30—39	40—49	50—59	60 *and over*	
European Males						
S_1	25·75	26·41	27·05	27·22	26·39	2·8%
S_3	33·73	32·94	33·59	34·32	34·43	3·1%
M + B	152·04	156·00	155·25	159·42	159·13	3·4%
European Females						
S_1	22·94	24·44	24·41	25·42	25·45	7·4%
S_3	29·18	29·64	30·82	30·42	32·35	6·7%
M + B	136·60	137·50	139·74	140·33	139·82	2·2%

V. Effect of such continuing Growth on the 149 Rule (in Europeans)

The effect which continuing growth of the sternum has on the applicability of the 149 rule is indicated in Table 6.

Table VI: Percentage Applicability of the 149 Rule in Different Age Groups.

Sex	*Age Groups*				
	20—29	30—39	40—49	50—59	60 *and over*
Males ..	64·5%	75·0%	74·5%	81·0%	84·4%
Females ..	93·5%	80·4%	70·4%	79·2%	75·0%

From Table 6 it is apparent that, with advancing age, the 149 Rule becomes progressively more applicable to the male sternum and progressively less applicable to the female sternum. Nevertheless, in all age groups, with the exception of the 20–29 year group in males, the 149 Rule is considerably more reliable than 'Hyrtl's Law'.

Discussion

There is no uniformity in the size of man. Some individuals are short in stature, others are tall. This is particularly true of a heterogeneous community such as is found in the British Isles. Certain bones vary in length approximately in proportion to body height. Therefore the range of variability in the lengths of individual bones is likely to be as variable as the heights of the individuals concerned. It has been shown that this statement is only in part true of the sternum, in which bone *absolute* measurements

vary, to some extent, with sex irrespective of body height. Certain measurements of the sternum have been shown to have a definite, though limited, value in differentiating between males and females. When it was thought, after Wenzel's observations, that the manubrial portion of the sternum is of almost equal length in men and women, and that the main differences between the sexes lies in the length of the mesosternal portion of the bone, it seemed obvious that the manubrium–corpus length-index must provide a reliable means for determining the sex of an isolated sternum. This would undoubtedly be true if the 'female' and 'male' manubrium–corpus *ratios* were constant irrespective of the *absolute* measurements of each portion of the bone. Unfortunately this is not so.

Dwight (*l.c.*) stated: 'While among women the sternum is shorter in proportion to height than in men, it is relatively smaller in the shorter women than in the taller ones'.

Krause (*l.c.*) observed: 'The greater the body height the shorter is the female manubrium in proportion to the mesosternum'.

These statements mean, in effect, that the taller (more 'masculine') a woman is, the more masculine in type her sternum will be, and the less likely will be the applicability of either 'Hyrtl's Law' or the rule which I have devised and called 'the 149 Rule'.

The reason why 'the 149 Rule' is, in fact, more widely applicable than 'Hyrtl's Law' is that the manubrium is not of such constant length irrespective of sex, as some observers have thought. I have found the European female manubrium to be definitely shorter than the male (average values 47.9 mm. and 52.2 mm. respectively). I have prepared graphs to indicate the frequency range of the lengths of manubrium and mesosternum separately, and combined, for both males and females (see graphs 21–23 in Fig. 8). It will be observed that, with the combined length the male and female blocks of values have tended to separate even further from each other indicating that this measurement is of more value as a differentiating feature than either of the other measurements singly. For comparison, in Graph 19 (Fig. 6) the manubrium–corpus ratios are shown according to 'Hyrtl's Law' and the differentiation between males and females is seen to be less than in Graph 23 (Fig. 8), which concerns 'the 149 Rule'.

Certain variable factors, which have not received adequate consideration in this connection will affect *any* law concerning the sex of the sternum.

i. One should note that, normally, the mesosternum is composed of 4 segments (Markowski, 1902). The occasionally encountered 2- or 3-segment mesosternum will inevitably be shorter than the usual 4-segment mesosternum, whether occurring in males or females. Likewise 5-segment mesosterna will be longer than 'average'.

ii. Occasionally the position of the 'sternal angle', i.e. the joint between 'manubrium' and mesosternum, may be at the level of the third costal cartilage instead of at the level of the second. In such cases the 'physio-

logical manubrium' is not the same as the 'morphological manubrium'. According to Schultz (1944), for morphological purposes the manubrium should be measured to the level of a line joining the middle of the second costal cartilages and not to the level of the misplaced sternal angle. I agree with Schultz for the following reason. If one measures to the apparent angle then the manubrium–corpus-index is found to be excessively high, i.e. in the region of 90%, whether in males or females. This fact is revealed by study of the findings of various observers concerning the measurements of such sterna. 'Hylobatian-type' sterna in Man have been reported by the following observers, and I have worked out the manubrium–corpus ratios as indicated in Table 7:

Table 7

Observer	*Sex*	*Manubrial Lenth as % of Mesosternal Length* %
Lane (1885)	F	92.0
Shepherd (1881)	M	87.5
Struthers (1874)	?	92.0
Dwight (1890)	M	*circa* 93.0
Paterson (1893)	M	100.0
Lickley (1904)	?	82.6

iii. In cases of synostosis at the meso-xiphi-sternal joint the exact dividing line between meso- and xiphi-sternum is often difficult to determine. As a result, individual observers may differ in their estimates of mesosternal length by several millimetres.

iv. Pathological (e.g. rachitic) sterna cannot be expected to obey any morphological laws.

v. Continuing growth of the sternum after the 20th year will slightly modify the value of any rule based on absolute measurements (see Table 6 which shows applicability of the '149 Rule' at various ages in Europeans).

In concluding this discussion one may say that, if confronted with a medico-legal or anthropological query concerning the identity of an isolated sternum, the investigator can only state that the sternum is either from 'a small to average-sized woman or small man' on the one hand, or from an 'average-sized to tall man or tall woman' on the other. If he gives a more definite diagnosis based on 'Hyrtl's Law' he will be correct in only about 65% of instances, whereas if he relies on the '149 Rule' he will be correct in about 80% of instances, provided, of course, there is reason for assuming that the specimen is from an individual of European or similar stock.

The male sternum is *absolutely* wider than the female sternum (Graphs 7–10, Fig. 3). With regard to *relative* width, one fact of considerable importance is rendered apparent by study of Table 5.

Concerning the increasing growth of the sternum after the age of 20 it

will be observed that the increase is of the order of 2—3% in all measurements in both sexes *except in regard to the width of the female mesosternum,* where the increase is of the order of 6—7%. This relatively excessive widening of the female sternum in middle life might well produce the so-called 'female' type of sternum described by Paterson and its development must surely have some physiological explanation. Being a phenomenon peculiar to the female sex and occurring as it does during the child-bearing period of life, it is suggested, without available proof, that it may result from the increased vascularity of the breast during lactation. The sternum, being supplied by the internal mammary artery, might reasonably be expected to share, and benefit from, the increased vascularity mediated through this artery.

Conclusion

From the evidence available, it is apparent that female sterna are generally shorter than male sterna, especially in the mesosternal portion. Further, there is a tendency for the mesosternum to become relatively wider in females than in males. However, the limited utility of existing methods of classifying sterna is obvious from the present study.

I have indicated elsewhere (Ashley 1951, 1953) that factors other than sex should be taken into consideration, and these factors will be discussed more fully in subsequent papers.

Summary

1. In Europeans, the female sternum, is on an average, smaller than the male sternum by from 7—13% according to which measurement is considered. In Africans, the female sternum is, on average, from 4—14% smaller than the male sternum.

2. In both males and females, the sternum continues to increase in both length and width throughout life. It is from 2—7% greater in these dimensions in the over 50-year-old group than in the under 40-year-old group.

3. Hyrtl's Law applies to less than 70% of sterna.

4. Absolute measurements may be utilised to differentiate male from female sterna. The '149 Rule' for Europeans, and the '136 Rule' for East Africans, apply to about 80% of sterna.

5. Increase in growth of the sternum throughout life affects the '149 Rule' to a moderate degree, but does not detract from its superiority over Hyrtl's Law.

6. A possible reason is put forward to explain the development of the so-called 'female type' of sternum described by Paterson.

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REVIEWS OF BOOKS

Legal Aspects of Medical Practice

The Physician and The Law. By Rowland H. Long. (Pp. 267 + Index. $5.75). 1955. New York: Appleton-Century-Crofts, Inc.

Contents: 1. The Relationship between Physician and Patient. 2. Malpractice. 3. Malpractice—Illustrative Cases. 4. The Physician's Defenses. 5. Diagnostic Aids as Evidence. 6. Autopsy. 7. The Responsibility of the Physician in Cases of Violent or Unexpected Death or Sudden Death from Natural Causes. 8. The Involuntary Commitment of the Mentally Ill. 9. Blood Group Tests and Blood Transfusions. 10. Artificial Insemination. 11. Adoption of a Baby. 12. The Physician and the Criminal Law. 13. Revocation or Annulment of License. 14. Compensation of the Physician and the Workmen's Compensation Law. 15. Insurance for Physicians. 16. Communications Made Privileged by Statute. 17. The Testimony of Experts. 18. On the Witness Stand. Glossary. Table of Cases. Index.

Mr. Rowland H. Long will be well known to the readers of this Journal because of his distinguished contribution on *The Expert Witness—A New Look*, which was published in Vol. 2, No. 2, pp. 67-74 (1955). Mr. Long is a member of the Massachusetts and New York Bars as well as Lecturer in Forensic Medicine at New York University Post-Graduate Medical School. He is therefore particularly well qualified to indicate to medical practitioners the obvious and the subtle ways in which their clinical practice is affected by the law. The monograph he has prepared on this subject is a valuable guide to the often perplexed practitioner, be he a beginner or a veteran.

The important topic of malpractice is covered in 2 chapters and is illuminated by instructive cases which illustrate, *inter alia*, problems arising in diagnosis, failure to use X-rays as an aid to diagnosis, the reasonably required use of the ophthalmoscope in eye conditions, disregard of the pathologist's report and the consequent removal of a breast, shock therapy and the use of known remedies (including the dangers of dicoumarol—Mr. Long refers to the South African case reported in this Journal in Vol. 1, No. 2, pp. 68-86, 1953) and reactions to antibiotics and other drugs.

A particularly useful chapter is the one dealing with *Artificial Insemination*, which sets out clearly in what ways the practitioner must protect himself, especially since (in the selection of a donor) 'the physician may assume a responsibility the nature and extent of which has not been presented to any court for determination' (p. 161).

Even the practitioner who is not a forensic specialist may often enough find himself in the witness box as an expert. No practising doctor should therefore neglect to study carefully the chapters dealing with *The Testimony of Experts* and conduct *On the Witness Stand.*

This interesting, readable and helpful book will undoubtedly also be of assistance to legal practitioners.

Professional Negligence

Professional Negligence. By J. P. Eddy, Q.C. With a foreword by the Right Honourable Sir Alfred Denning. (Pp. 140 + Index: 13s. 6d.) London: Stevens & Sons Limited, 1955.

Contents: 1. Foreword. 2. Preface. 3. General Principles of the Law of Negligence. 4. The Law and the Lawyers. 5. Bankers, Accountants and Auditors, and Company Secretaries. 6. Doctors, Hospitals and Dentists. 7. Other Professions. 8. Summing-Up.

It is one of the features of professional activity under the National Health Service in the United Kingdom for medical practitioners to find themselves increasingly at risk as far as actions for negligence instituted by patients are concerned. This development is perhaps not entirely unexpected and has made Mr. Eddy's monograph all the more timely. The figures indicating the trend of events are most disturbing. Hospital Authorities paid out in compensation of all kinds the sum of £7,500 in 1948-49. In 1950 it was £23,000; in 1951 it was £38,000; in 1952 it was £106,000 and in 1953 the figure reached £153,000 (p. 79). The case of *Cassidy* v. *Ministry of Health* has undoubtedly been an important cause of the increase of litigation, since the hospital is now held responsible for *all* those in whose charge the patient was.

Medical practitioners will be primarily concerned with the sections on their own liabilty as doctors, injury due to inevitable accident (the problem of the broken needle in the course of an injection), the need for warning, consent to physical intervention and the duty of professionad secrecy.

Legal practitioners will find of the greatest assistance this concise but comprehensive survey not only of their own problems, but also those of a variety of other professions.

The volume can be recommended very strongly.